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SHOULD MEDICAL INVENTIONS BE PATENTED?

By ARTHUR G. CONNOLLY

WILMINGTON, DELAWARE

FOR some years the medical profession has been confronted with the question of whether or not it is ethical to obtain patent protection on medical inventions. The pros and cons of this question have been argued ad infinitum, and so far as the writer can determine in his contacts with members of this profession no general agreement has as yet been reached. It appears that on this subject the medical profession is still split roughly into two groups, one of which asserts that it is quite proper to obtain patent protection on medical inventions, and the other of which asserts that such procedure is unethical and a violation of the doctor's duties to the public.

The writer has on frequent occasions been retained by doctors to obtain patent protection on their inventions, and during the course of this work he has invariably been requested to give his views on the desirability of patenting medical inventions from the standpoint of the doctor's duty to the public. Because of the apparent interest of the medical profession in this question it is believed that a brief résumé of the fundamentals of patent law and their application to medicine, biochemistry and related fields might be of assistance to those physicians who at some time during their careers may become inventors and be confronted with the difficult question of what they should do with their inventions.

Although the writer's profession is patent law every effort has been made to approach this question from as fair and impartial a position as possible. The reasoning upon which the conclusions are based has been reduced to practically axiomatic principles, and it has been attempted to explain these principles in such plain language that the non-legal reader should have no difficulty in forming his own opinions. In this manner it is believed that any unintentional bias will be most successfully avoided.

Before going into this article further it might be

well to state that its author is convinced that the true position in this controversy, both from the standpoint of the medical profession and the general public, is one which so far as he knows has never been advanced before, namely, *that it is unethical not to patent medical inventions.* The purpose of the following discussion is to give the reasons for this conclusion, which to many may appear rather startling. For that reason, this discussion will attempt to briefly cover the background and fundamentals of patents and lead up to the crux of the general argument previously referred to. It is hoped that those readers who do not believe in patents will bear with the writer, at least to the point where they are assured that they have not previously overlooked certain phases of patent law which are discussed in this article and have a vitally important bearing on this general question.

When the founders of our country drafted the Constitution they realized that in order to promote the progress of science and the useful arts it would be necessary to secure for limited times to authors and inventors the exclusive right to their writings and their discoveries. This provision is found in Article I, Section 8, of our Constitution. The necessity for a provision of this type goes back hundreds of years before the settlement of America by our forefathers, when it was customary for inventors to surround their inventions with the utmost secrecy and to pass them down from father to son. The guilds of England and Continental Europe were an outgrowth of this antiquated system, and they surrounded their inventions with a cloak of secrecy which was seldom penetrated. This ritualistic secrecy successfully prevented a large mass of the public from obtaining any benefits whatsoever from the invention and exacted a heavy toll from those who did partake of its benefits. As a result, the progress of civilization was appreciably retarded because generations would pass before an invention which might be of profound interest to the public was added to the general store of human knowledge.

The provision in our Constitution which has been referred to and the patent laws of our country which are based thereon were merely attempts on the part of our far-seeing law-makers to overcome this archaic state of affairs and advance civilization as rapidly as possible by widely disseminating complete and accurate information on all valuable inventions and contributions to the arts and sciences. Naturally, the majority of inventors would not care to disclose their inventions to the public unless they received something in return, and therefore patent protection was advanced as a reward. Crudely speaking, a patent may be looked upon as a bait to induce one who possesses a valuable secret to disgorge it. The great majority of doctors are not interested in any financial reward from their inventions, and are sufficiently public-spirited to render these inventions available to the general public as soon as humanly possible. Consequently, if this were the only benefit to be obtained from a patent they would be only too glad to forego it. However, there are other benefits from a patent which are of much greater value than mere financial reward, since they redound to the advantage of practically every man, woman and child, and these benefits will be referred to in a subsequent portion of this article.

In order to obtain a patent it is necessary for the inventor to file in the Patent Office an application disclosing his invention in detail and claiming it in a clear and concise manner. The purpose of the detailed disclosure is to enable the public to practice the invention after the patent expires. The purpose of the claims is to point out to the public what it may not practice before the patent expires.

When this application is received in the Patent Office it is assigned to a patent examiner whose duty it is to determine whether it discloses and claims a patentable invention. This examiner studies the application and advises the applicant whether it is in patentable form or is defective because the invention was first discovered by another or for some other reason. In the event that the examiner is of the belief that the application is defective because the invention was first discovered by another he notifies the applicant of his decision and refers to the publication which to his mind shows that the invention was first discovered by another. An interesting situation now arises, because even though this publication describes the identical invention of the patent application if it was not published more than two years before the patent application was filed the applicant may present the patent examiner with an affidavit, signed only by himself, stating that he made the invention in this country prior to the date of the publication. The patent examiner is then compelled to ignore this publication, and unless there is some other defect in the application it will issue as a patent covering the same invention as is described in the publication. During all this period the application has been kept secret by the Patent Office and no member of the general public has been permitted to examine it.

It will now be seen that even though one is sufficiently public-spirited to desire every one to have the unhindered use of his invention and to that end publishes a complete description of it in a recognized professional journal, there is still a distinct possibility that another may subsequently obtain a patent on that very invention and control its use in whatsoever manner he pleases. All this other party need do is to

apply for a patent on the invention at any time within two years after it is described in the professional journal and when he is confronted with this journal have it removed from consideration by filing an affidavit stating that he made the invention in this country before the date of publication of the journal. The Patent Office is here at a distinct disadvantage because it can not call for assistance upon the party who wrote the article for publication. It has nothing to rely upon but the date of publication of the journal, and the affidavit of the patent applicant is sufficient to overcome that. As a result it must necessarily disregard the article in the journal and issue the requested patent.

It should here be borne in mind that the party applying for the patent may not be dishonest and his affidavit may be entirely truthful because he may actually have made the invention in this country before the date of publication of the journal. Even though the doctor who published his article in the professional journal was in fact the first inventor, since he did not see fit to apply for a patent he is not in a position where he can assist the Patent Office by proving his earlier date of invention, and the Patent Office is perforce compelled to rely upon the only date which it has at its disposal, namely, the date of publication of the journal.

Thus, it can be seen that even though the first inventor refuses to patent his invention and earnestly endeavors to render it available to every one by publishing it in a professional journal this does not necessarily prevent another from patenting it and withholding its benefits from the general public. In fact, even the first inventor himself may be forbidden to use his own invention unless he wishes to engage in a costly patent contest wherein his opponent, the patentee, is given the benefit of every doubt. These patent contests, whether in the Patent Office or the courts, almost invariably involve the expenditure of thousands of dollars, and it is not at all uncommon for them to cost each of the contestants as much as one hundred thousand dollars. Needless to say, a doctor of moderate means would hesitate to engage in such a contest, even though he were reasonably certain of ultimately emerging victorious.

When one finally receives a patent from the United States Government he has been awarded, for a period of seventeen years, the privilege of preventing others from trespassing within the limited portion of the field of science which has been set out in the claims of the patent as his invention. This patent may then be used as a club during the ensuing seventeen-year period in order to drive out of this restricted field any and all trespassers, or it may be used merely to drive out certain trespassers whom the patentee considers to be undesirable, or it may be dedicated to the public and every one permitted to freely enter its field. How it will be used depends solely upon the will of the patent owner.

At this point it may be well to state that certain patent owners have exercised their patent, or club, in such manner that a very desirable invention has been withheld from the public for an extended period of time. The method which these patent owners generally adopted was to require all who wished to enter their patented field to pay an exorbitant price. Those few who were willing to meet this demand were naturally compelled to pass on this exorbitant price by charging more for their products than would have been the case if their admission fees to the patented territory had been reasonable. The public was bound to be injured by this practice, since many of its members could not afford to purchase the patented products and were unjustly deprived of their beneficial effects. This is the condition which is generally taken as an example by those members of the medical profession who oppose patents, and to such opponents of patents the writer would like to state that if all patents were treated in this manner their position would be untenable and any doctor who obtained a patent on a medical invention would be violating the oath of his profession and his duties to the public.

However, the use which is made of a patent after it has issued depends solely upon the desires of the patentee, and this patentee may develop his patent in such manner that the public receives far greater benefits from his invention than would have been possible otherwise. A patent is merely an instrument in the hands of an individual, just as a scalpel is an instrument in the hands of a surgeon. It can be used for good or evil, and how it is used is governed by the dictates of the individual in whose hands it has been placed. Merely because a scalpel or some other well-known instrument has been used in a harmful manner on occasion does not mean that it is a destructive instrument which should be looked upon with distrust. On the contrary, it is the individual who has perverted a useful instrument who should be shunned, not the instrument. In the same manner, merely because a patent has been exploited by an avaricious individual does not indicate that it is a harmful and untrustworthy instrument. The patent is an instrument of value to the medical profession just as is the scalpel and innumerable other useful instruments.

The doctor who obtains a patent on his medical invention has in his hands an instrument which is extremely useful. He may, by means of his patent, regulate the care which is taken in producing his patented product so that there will be no danger of an inferior product being sold to the public. He may

require this product to be sold at a price which is within the reach of practically every one, thereby preventing any unscrupulous concerns from charging an exorbitant price for the patented product. He may admit to his patented territory any and all individuals or companies which have a high reputation for integrity, and at the same time he may exclude from this territory all individuals and companies whose reputations are not of the best. In brief, he may by a proper development of his patent permit the public to obtain a product of the highest quality at a price which is much more reasonable than if it were left to the dictates of the individual manufacturers.

If a medical invention is not patented practically any individual or concern is at liberty to manufacture the product and offer it to the public. It goes without saying that not all individuals and concerns are of the highest type and assume a real responsibility towards the purchasers of their products. Without a patent the only determining factors with respect to the price at which the product will be sold are the general factors of competition and the manufacturer's desire to make a profit. This state of affairs leads to the undesirable result that in order to make a large profit and yet meet competition certain manufacturers may take "short cuts" in the manufacture of the product. In other words, expensive steps and ingredients in the process whereby the product is made may be omitted entirely or replaced by less expensive steps and ingredients. Needless to say, such expedients will customarily produce a product of inferior quality. However, because of the economies made in the manufacture of this product the manufacturer is in a position to reap a large profit and yet undersell those of his competitors who have observed their responsibilities to the public. The purchasing public can seldom distinguish between a good medical product and an inferior one by mere inspection, and it has an understandable tendency to buy the more economical product. As a result, the manufacturer who undersells his competitors possesses a recognized trade advantage. If he gains this advantage by sponsoring an inferior product, while this may injure him over a period of time, its immediate effect is to harm the purchaser, the prescribing physician and his reputable competitors.

At this point it may be asked whether or not the present laws do not prevent the marketing of inferior medical products. The answer to this question is generally conceded by all familiar with the subject to be in the negative. The present laws are woefully inadequate and may be readily evaded by those manufacturers who indulge in the practice of underselling their competitors through the medium of an inferior product. If the doctor who makes a medical invention has not obtained patent protection for it he has deliberately placed the public in a position where it may become the prey of unprincipled individuals and concerns. He has, likewise, added another burden to those reputable concerns which maintain a high standard, by compelling them to compete in the open market with their less desirable competitors.

These disadvantages may be eliminated by means of a patent which protects the invention in question. This patent in the hands of a high-minded and conscientious doctor is at the present time the most effective instrument that could possibly be obtained to protect the public, the reputable pharmaceutical companies and the medical profession as a whole. Without it the invention becomes the toy of the unprincipled and avaricious manufacturer at the expense of the remainder of the public.

In the above discussion it has been shown that:

(a) Even though the inventor refrains from patenting his invention he does not necessarily prevent others from patenting it.

(b) If a patent is obtained by others it may be developed in a manner which is detrimental to the public, and in any event such development depends upon the discretion of another.

(c) If the invention is not patented there can be very little control over the quality of the product, and over the price at which it is offered to the public.

By a proper recourse to our patent laws the doctor may obtain a patent on his invention and control its use in such a beneficial manner that all companies of doubtful integrity are excluded from its field, and those companies which are admitted to the patented field are compelled to abide by very rigid restrictions as to the quality of the product which they manufacture and the price at which they sell it. In this manner, the price may be fixed at a level which while permitting the manufacturer a reasonable profit prevents any overcharging of the public. Furthermore, if one does not wish to take the trouble of developing a patent in order to assure the public of a product of high quality and reasonable price, the patent may be dedicated to the public merely by filing a statement to that effect in the Patent Office at any time before or after its issuance. The public is then just as free to use the invention as though it had never been patented, but there is no longer the danger of an unprincipled third party becoming aware of it and obtaining a patent thereon without the true inventor being consulted in the matter.

In conclusion, therefore, it is submitted that a doctor who discovers a valuable medical product and fails to protect it by a patent is deliberately refusing an opportunity of controlling the production and sale of

his product in such manner that it would be of maximum benefit to the public. Furthermore, he has left his invention in the position where another might patent it and use the patent to the detriment of the public. Every valuable medical invention should be protected by a patent, and this patent should be licensed only to reputable manufacturers who agree to abide by rigid restrictions as to the quality and maximum sales price of the patented product which they produce. In fact, it would probably be helpful if the medical profession would have a central committee which would protect by patents inventions of the profession, and which would develop these patents in such manner that the public received the greatest benefits therefrom. If the doctor feels that the development of his patent involves too much trouble he should at least obtain the patent and dedicate it to the public, thereby preventing any one else from patenting his invention and using the patent to the detriment of the public.

SCIENCE AND SOCIETY

By Dr. F. R. MOULTON

PERMANENT SECRETARY, AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

INTRODUCTION

AT the meeting in Indianapolis next December the first of a series of "conferences" (symposia) on "Science and Society" will be held under the auspices of the association. Since these five conferences form an integrated whole and in certain other respects differ somewhat from those heretofore organized by sections of the association and by its affiliated societies, their scope and purpose will be briefly described.

These conferences will systematically cover the broad subject of the effects of the impact of science upon human beings, both as members of society and as individuals. In these discussions the whole range of science will be involved. At one extreme, there will be the physical sciences and technology; at the other, the social sciences and the organization of society. These conferences together will constitute a synthesis of the interrelations of science and life. In this rapidly changing and disturbed world no greater theme can engage the serious attention of high-minded men.

The outlines of the conferences which follow this introduction will make clearer than any general description their scope and character. Outlines of four of the five conferences are here presented together because their full significance would not readily be perceived from reading first one and then another at intervals of six months as they will appear in the programs of the association. Although the fifth conference is described only by the title "Science and Human Beings," it is clear that in certain respects it will be the climax of the series, for man himself is the object of our highest and ultimate interest.

It is hoped that this project will receive the approval and hearty cooperation of the members of the association. It is hoped, too, that it will be followed by many other conferences and series of conferences that will somewhat similarly range across the boundaries that divide up the domain of knowledge into separate subjects. At the same time, comprehensive symposia on limited subjects of the types that have become distinguishing characteristics of the meetings of the association should by all means be continued. For example, the symposium on cancer at the Atlantic City meeting by the Section on Medical Sciences was of the highest order of excellence and usefulness, as have been many other symposia organized by various sections. If, without ceasing to make such penetrating examinations into special subjects, the association from time to time can undertake surveys and syntheses of broad fields, it will better serve science and society.

FOREWORD TO CONFERENCES

The purposes of this projected series of five conferences, to be held at successive meetings of the association, are: first, to investigate and present in a systematic and comprehensive way the effects of science and its applications upon society and upon human beings as individuals; and, second, to indicate the ways in which economic, social and political institutions affect scientific developments.

It is recognized in a general way that science is by far the most important influence to which the human race has ever been subject. Even within the short interval of a hundred years science has transformed the whole environment and outlook of man. By placing great forces and new techniques at his command it has enormously increased his ability to satisfy his physical wants. In his economic and social relations, it has changed him from a largely self-sufficient individual into one essentially dependent on the remainder of the world. On the intellectual side, it has provided him abundant leisure and unparalleled facilities for cultivating his mind, given him new conceptions and powers, and opened up new vistas for further exploration.

At the same time, however, the rapidity with which

epoch-making scientific discoveries have been made in recent decades has given rise to problems of far-reaching importance. The impact of new scientific discoveries on processes of wealth-production has at times created serious economic and social maladjustments; and the fear has frequently been expressed that science and technology may even come to be the master rather than the servant of mankind—if, indeed, they may not lead to the destruction of society.

Reciprocally, changing economic conditions and imperfections in the operation of the economic system react upon the development of science. Moreover, confused and conflicting views with respect to the present and future of science and its applications pervade public discussions and thus lead to governmental regulations and controls often inimical to science and society.

It is for the purpose of providing a more adequate conception of the significance of science in social and human developments that this series of five conferences has been organized. It is intended that they shall be factual and quantitative, rather than speculative and vaguely general.

They will present existing facts and conditions in historical perspective and will also look in some measure toward the future. As a whole, they should afford a comprehensive and realistic picture of the importance of the supremely important interrelations of science and society.

No other organization appears so well qualified to sponsor conferences on this broad subject as the American Association for the Advancement of Science—for the association, through its 16 sections and its 162 affiliated societies, covers the whole range of pure and applied science. It is able, from its own membership, to enlist the cooperation of specialists from all the fields of the natural and the social sciences. Moreover, its age, its large membership and its facilities for publication make the association the most influential medium for bringing the results of such an inquiry to the thoughtful consideration of the public.

Plan of the Conferences

Each of the conferences will consist of five sessions. At each session not more than two papers will be presented. Since only about an hour and a half will thus be required for any session, it is hoped that conflicts with other programs of major importance may be largely avoided. Although five conferences, held at successive meetings of the association, will be required to cover the broad subject outlined, each conference is so organized as to be a complete unit in itself, and it is planned to publish the papers given at each conference in a volume of convenient dimensions.

The first conference of the series will be held at the Indianapolis meeting of the association in December, 1937. The address of the retiring vice-president of the Section on Social and Economic Sciences will constitute the first session of the conference. This address is intended to serve as an introduction, not only to the first conference, but to the entire series of conferences. The papers in the succeeding sessions of the first conference will be contributed by eminent authorities, selected because of their particular competency to illuminate the various aspects of the problem under consideration.

The tentative titles selected for the five conferences are as follows:

Conference I. Fundamental Resources as Affected by Science
Conference II. Standards of Living as Affected by Science
Conference III. The Economic System in Relation to Scientific Progress
Conference IV. Government Policies in Relation to Scientific Progress
Conference V. Science and Human Beings

Dr. Harold G. Moulton, president of the Brookings Institution, upon invitation of the council of the association, has agreed to organize the entire series of conferences, thus ensuring unity in conception and continuity in administration.

SCIENCE AND SOCIETY

A series of conferences to be held
under the auspices of the
American Association for the Advancement of Science
(Tentative Outline)

First Conference (December, 1937)

Fundamental Resources as Affected by Science

Session I. Controlling Factors in Economic Development

This paper will be given by Harold G. Moulton as a retiring vice-presidential address. Its major purpose will be to serve as a general introduction to the whole series of conferences. It will therefore emphasize the combined and interrelated influence upon economic progress of the development of science and the evolution of economic, political and social institutions.

Session II. Natural Resources

Paper 1. Agricultural and Forest Resources

Paper 2. Mineral Resources

The primary purpose of the papers on these subjects should be to show the ways in which the applications of science to agriculture, forestry and mining have served to amplify and to increase the productivity of these basic natural resources.

Session III. Power and Capital Resources

Paper 1. Power Resources

The development and use of various forms of power—steam, oil, electric, etc.—during the past century has revolutionized the processes of pro-

duction. The purpose of this paper should be to set forth in a systematic way the developments which constitute the power revolution and to indicate its bearing upon man's mastery of the physical world.

Paper 2. Capital Resources

This paper should stress the significance of capital, that is, plant and equipment, in increasing man's ability to provide for his wants. Attention should be directed not only to the expanding size of productive establishments and organizations but also to the increasing size and efficiency of productive instruments.

Session IV. Human Resources

Paper 1. Man Power

This paper should be devoted to an analysis of the changing rates of growth and changing age distribution of the population and the bearing thereof upon economic expansion, productivity and living standards.

Paper 2. The Utilization of Human Resources

This paper should be devoted to a discussion of the problems involved in increasing the efficiency of human resources. It should cover such questions as the distribution of population between rural areas and urban centers, migrations, the selection and training of personnel for given tasks, education, health conditions, etc. The focus would be upon labor as a factor in production. (Note that the Fifth Conference would be devoted to a discussion of the effects of science upon human beings as members of society.)

Session V. The Application of Science to Business

Paper 1. Scientific Methods in Business Organization

Paper 2. Research Laboratories and the Spirit of Science

These two papers should be devoted to an analysis of the problems involved in continuously promoting the application of science to the problems of business. The first paper should discuss the application of scientific methods in connection with all phases of business activity. It would be concerned with such problems as those usually included under such headings as Industrial Engineering, Scientific Management, etc. The second paper should stress the importance of conducting basically important scientific investigations by industries and the influence of research laboratories in promoting the scientific point of view throughout industrial enterprise.

SECOND CONFERENCE (JUNE, 1938)

STANDARDS OF LIVING AS AFFECTED BY SCIENCE

Session I. The Progressive Improvement of American Living Standards

This first paper should serve as a general introduction to the Second Conference. It should review the history of living standards in the United States, attempting to measure as accurately as possible the improvement in the economic position of the American people, giving attention both to working hours and values produced. If space permits, an analysis also should be made of the varying standards of living among the different groups in the body politic.

Session II. The Development of Steel and Non-ferrous Metals

Paper 1. Production and Uses of Steel and its Alloys

Paper 2. Production and Uses of Non-ferrous Metals

In both of these papers attention should be given not only to the relation of the metal industries to productive efficiency but also to consumptive satisfactions.

Session III. The Scientific Utilization of Coal and Petroleum

Paper 1. Coal and its Derivatives

Paper 2. Petroleum and Natural Gas

The purpose of these papers should be to show the ways in which the applications of science have increased the efficiency and widened the uses of these resources. It would differ from the paper on Mineral Resources in the preceding conference in that it would give more specific attention to the particular products here considered.

Session IV. Applications of Science in the Textile Industry

Paper 1. The Transformation of Raw Materials into Finished Products

This paper should explain the ways in which scientific developments have increased the efficiency of production and improved the quality and serviceability of the product.

Paper 2. Chemical Equivalents of Textiles

This paper should discuss the ways in which chemistry has created textile substitutes.

Session V. Scientific Developments in Transportation and Communication

Paper 1. Transportation

A review of the significance of science in transportation development, with special emphasis upon the potentialities of further scientific advancement, particularly in the fields of rail and air transportation.

Paper 2. Communication

A review of scientific developments in telegraphy, telephony, radio and other forms of communication; and a discussion of their economic significance, actual and potential.

THIRD CONFERENCE (DECEMBER, 1938)

THE ECONOMIC SYSTEM IN RELATION TO SCIENTIFIC PROGRESS

Session I. Free Enterprise and Scientific Development

This paper should serve as an introduction to the Third Conference. Its principal purpose should be to explain the essential elements of the so-called system of free enterprise, including the operation of the price and profit mechanism; show how this

system has promoted the development of large-scale business organizations; and indicate the ways in which the system of free enterprise has stimulated the development of science and its application to business enterprise.

Session II. The Monetary and Credit System

Paper 1. The Significance of Money

The purpose of this paper should be to set forth the various functions performed by money and the factors upon which a satisfactory monetary system depend.

Paper 2. The Significance of Credit

This paper should discuss the development of both short-term commercial credit and long-term investment credit, and indicate the functions performed by the various types of financial institutions and agencies which comprise the financial system as a whole.

Session III. Fluctuation in Business Activity

Paper 1. Factors Affecting the Long-run Trend of Prices

This paper should discuss both monetary and industrial factors affecting the secular movement of commodity prices.

Paper 2. The Business Cycle

This paper should constitute a review of the history of cycles, with an account of the varied explanations of the cause of business oscillations; and indicate the ways in which such fluctuations stimulate and retard the application of science to industry.

Session IV. Economic Requirements for Progress

Paper 1. Factors Affecting Productive Efficiency

This paper should be devoted to a consideration of the significance of a continuous expansion of capital and of the impediments which retard the introduction of improved methods and processes in production.

Paper 2. Distributing the Benefits of Progress

This paper should analyze the mechanisms and processes by means of which the benefits of increasing productivity are disseminated among the masses of the people.

Session V. The Scientific Approach in Economics

Paper 1. Potential Contributions of the Natural Scientist to Economic Analysis

This paper, to be presented by an engineer or physicist, should indicate the ways in which methods developed in the natural sciences might be more extensively utilized in the solution of economic problems.

Paper 2. Scientific Methods in Economic Investigation

A discussion by an economist of the utilization of scientific methods in economic analysis. Attention should be given to the extent and character of the aid that may be obtained through cooperation with natural scientists.

FOURTH CONFERENCE (JUNE, 1939)

GOVERNMENT POLICIES IN RELATION TO SCIENTIFIC PROGRESS

Session I. The Changing Rôle of Government in Economic Enterprise

This introductory paper should briefly survey the relation of government to economic enterprise (a) in the Middle Ages, (b) under the so-called *laissez-faire* system of the nineteenth century, and (c) under present-day conditions. It should outline the manifold ways in which the government to-day attempts to assist, regulate and control business activities, as well as those which are designed to restrain or curb business activities.

Session II. The Patent System

Paper 1. The History of Patent Rights

A summary history of patented appliances and devices, together with a discussion of the influence of business fluctuations upon applications for patents.

Paper 2. An Appraisal of the Patent System

An analysis of the efficacy of the existing patent system, including a discussion of business policies which affect the prompt utilization of new patents.

Session III. Government Credit and Business Enterprise

Paper 1. The Expansion of Governmental Enterprise

A survey of the expansion of governmental activities over the past thirty years, in both the United States and other countries. The study should indicate the variety of activities in which the government engages and point out the factors which appear to be responsible for the developments which have occurred.

Paper 2. Governmental Enterprise and Taxation

This paper should analyze the growth of public indebtedness in relation to the growth of producing and tax-paying power. Some forms of governmental activity produce revenues, while others do not. The central purpose of this paper should be to reveal the extent to which the *burden of taxation* has been increased by the expansion of non-revenue-producing government enterprise.

Session IV. Government Credit and Economic Stability

Paper 1. The Problem of Fiscal Stability

This paper should build upon the materials assembled in the preceding session, focussing attention upon the present condition of government budgets in the United States and other leading countries.

Paper 2. Fiscal Stability and Monetary Stability

This paper should analyze the relation of fiscal stability to monetary stability and the bearing of both upon the conduct of business enterprise.

Session V. The Scientific Approach in Government

Paper 1. Political Organization and the Scientific Spirit

An analysis of the way in which our political organization and legislative and executive procedures affect the scientific approach to government prob-

lems, together with a discussion of the extent to which governmental agencies engage in and promote scientific investigations.

Paper 2. The Future of Science in Relation to Government

A discussion of the problems involved in introducing the scientific spirit into governmental organization and enterprise and of the ways in which scientific bodies might contribute toward this end.

FIFTH CONFERENCE (DECEMBER, 1939)

SCIENCE AND HUMAN BEINGS

(Outline not as yet prepared)

SCIENTIFIC EVENTS

DEDICATION OF THE NEW BUILDING OF THE COLLEGE OF MEDICINE OF SYRACUSE UNIVERSITY

THE new building for the College of Medicine of Syracuse University will be dedicated on November 22. It is the fourth unit in the plan started in 1935 to construct a hospital and educational center adjoining the campus. Units completed are the Syracuse Memorial Hospital, a state psychopathic hospital and the communicable disease hospital. These institutions are affiliated with the College of Medicine. The cost of the new building was $825,000. It includes six large student laboratories for physiology, bacteriology, chemistry, pathology, anatomy and pharmacology in addition to research laboratories for members of the faculty. There is an auditorium on the first floor, seating 400 persons.

The building is of English Georgian design and was planned by the late James Russell Pope and by Dwight James Baum, of New York City. It conforms in architecture with the building of the Maxwell School of Citizenship and Public Affairs. The latter building is to be dedicated ten days before the medical building.

Dr. Ray Lyman Wilbur, president of Stanford University, will be the principal speaker at the dedication exercises. Other speakers will be Dr. Henry A. Christian, of Harvard University, who will represent the practice of medicine, and Dr. Edward S. Godfrey, Jr., commissioner of the State Department of Health, who will represent the field of public health. Alumni of the College of Medicine will meet in the new building on November 20 and the building will be open for public inspection on Sunday.

President Roosevelt laid the cornerstone for the new building in 1936 and it was constructed from funds from a Public Works Administration loan. The College of Medicine is 103 years old, having been established at Geneva in 1834. It was moved to Syracuse as a division of the university in 1871.

RESEARCH GRANTS OF THE PHILADELPHIA COLLEGE OF PHARMACY AND SCIENCE

DR. ARNO VIEHOEVER, director of the Gross Laboratory for Biological and Biochemical Research of the Philadelphia College of Pharmacy and Science, has announced the receipt of two research grants.

The first of these is a fellowship established by Merck and Company, manufacturing chemists of Rahway, N. J. The research is to be carried out under the direction of Dr. Viehoever with the assistance of Dr. I. Cohen of the laboratory staff. The Gross Laboratory, which developed and improved the technique in the evaluation of potent drugs, using the minute transparent laboratory test animal, Daphnia, will apply this method to work with the factor in wheat germ oil, Vitamin E.

Simultaneously with the award of this grant, the college, through Dean Charles H. LaWall, announced the establishment of a graduate fellowship for study and research under the program embraced by the Gross Laboratory. This grant, personally established by Dr. Joseph Rosin, vice-president and chief chemist of Merck and Company, includes all fees and a stipend for a student pursuing work leading to a graduate degree. Students, preferably those who have earned baccalaureate degrees in chemistry, should communicate with Dr. J. W. Sturmer, dean of science, who may be addressed in care of the college.

The Gross Laboratory, at which the research will be carried out, was established in 1934. It is supported by William H. Gross, of Philadelphia. The laboratory is situated at 4212 Kingsessing Avenue, near to the other buildings of the institution. Researches in this laboratory are devoted to the advancement of biological and biochemical knowledge.

CONFERENCE ON THE PHYTOHORMONES

A CONFERENCE on the subject of phytohormones was held at the International Institute of Intellectual Cooperation, Paris, on October 1 and 2. This meeting, which was organized by the International Institute of Intellectual Cooperation and the International Union of Biological Sciences, is the first of a series that will be held in the course of the coming months to discuss a variety of questions such as "The New Vitamins," "The Nomenclature of Genetics," "The Double Electric Layer," etc., subjects included in the plan of work of the International Council of Scientific Unions, which acts as a Committee of Scientific Advisers to the institute.

The meeting was held under the chairmanship of Professor P. Boysen Jensen and discussed the following reports:

Chemistry of Phytohormones and Other Growth Substances, Professor F. Kögl.

Phytohormones in the Different Plant Groups, Professor Niels Nielsen.

The Problem of Phytohormones and the Metabolism, Professor V. J. Konigsberger.

The Notion of Phytohormones: their Relations to Stimulants and the Irritability of Plants, Professor George S. Avery.

The Action of Phytohormones on Growth, Cell Division and Organo-Genesis, Professor R. Bouillenne.

Phytohormones and the Movements of Plants, Professor Boysen Jensen.

Influence of Animal Hormones on Plants, Professor Zollikofer.

Correlations and Phytohormones, Professor R. Dostal.

Nomenclature of Phytohormones, Dr. Janot.

The question of the nomenclature of phytohormones gave rise to an exhaustive discussion and definite results were reached.

The reports, and the discussions to which they gave rise, will be published under the auspices of the institute and of the International Union after revision by Professor Boysen Jensen before publication.

A second meeting will be held at Copenhagen at the end of September, 1939. Professors Boysen Jensen, Laibach and Koningsberger have been invited to organize this meeting from the technical point of view, in collaboration with the union.

THE NATIONAL ASSOCIATION OF AUDUBON SOCIETIES

THE National Association of Audubon Societies held its thirty-third annual convention at the American Museum of Natural History in New York City from October 22 to 26. The convention opened on the evening of October 22, with a reunion dinner of the Audubon Nature Camp established two years ago on Hog Island in Muscongus Bay, Maine, where teachers of wild-life appreciation and conservation are given an opportunity to observe wild life to receive instruction in leading nature study groups. On Saturday and Sunday field trips were conducted by members of the staff to sanctuaries at Cape May Point, N. J., and to Montauk Point, L. I.

The sessions were held on October 25 and 26. Dr. T. Gilbert Pearson, president emeritus, spoke on the need of bird protection in Mexico and the islands of the Caribbean Sea; Robert P. Allen, sanctuary director, gave an illustrated account of Texas coast sanctuaries, and Victor H. Cahalane, of the National Park Service, discussed the status of the Big Bend National Park in Texas. The afternoon session was devoted to a summary of present and prospective wild-life research activities throughout the nation. The speakers included: W. L. McAtee, of the U. S. Biological Survey; A. A. Nichol, of the University of Arizona; James Tanner, of Cornell University; Dr. Homer L. Shantz, chief of the Wildlife Division of the U. S. Forest Service. I. T. Bode, of the Extension Service of the U. S. Department of Agriculture, spoke on the nature education and conservation promotion activities among the farm boys and girls of the 4-H Clubs.

On Tuesday afternoon Dr. Ira N. Gabrielson, chief of the U. S. Biological Survey, summarized the present status of migratory water-fowl in the country and discussed measures necessary for their protection in order to preserve certain species from extinction. This was followed by a discussion of Florida birds when four of the sanctuary wardens of the association described their experiences in guarding the rare birds of southern Florida.

The annual dinner was held in the evening at Essex House. Sound films of birds photographed in their native habitats were shown by Dr. Arthur A. Allen, professor of ornithology at Cornell University. Special emphasis was placed on the better-known species, so that the average amateur might be able to identify familiar species. Color films were also shown of spectacular birds indigenous to the tropical regions of Florida and Texas. These pictures were presented in connection with the campaign to bring about the immediate establishment in Florida of the proposed Everglades National Park and in Texas of the Big Bend National Park, before commercial exploitation and unchecked hunting make those areas unfit for the purpose.

THE SUMMER MEETING OF THE AMERICAN MATHEMATICAL SOCIETY

THE forty-third summer meeting and the twentieth colloquium of the American Mathematical Society was held at the Pennsylvania State College from September 7 to 10 in conjunction with the summer meeting of the Mathematical Association of America. About 475 persons attended the meetings, of which 275 are members of the society.

Four colloquium lectures on "Continuous Geometry" were delivered by Professor John von Neumann, of the Institute for Advanced Study at Princeton. The attendance at these lectures was 169. They will be published by the society in book form. Professor Hassler Whitney, of Harvard University, gave an invited address entitled "Topological Properties of Differentiable Manifolds."

Seven sessions for brief reports on individual research work were held during which a hundred and one such reports were presented.

Detailed preparations were made for the semicentennial meeting of the society to be held in New York City from September 6 to 9, next year. An excellent scientific and social program has been planned, and the largest attendance in the history of the society is expected. Committees were also appointed to make

arrangements for the International Congress of Mathematicians to be held in Cambridge, Mass., early in September, 1940.

The Mathematical Association of America met on Monday afternoon and Tuesday morning, September 6 and 7. At the closing session, Professor G. A. Bliss gave an address on the life and work of Professor Herbert Ellsworth Slaught (1861–1937). The Mathematical Association of America was founded in 1916 under the inspiration and guidance of Professor Slaught.

The arrangements made by the department of mathematics and other departments of the Pennsylvania State College for the convenience and entertainment of the visiting mathematicians and their guests left nothing to be desired. The joint dinner of the two mathematical organizations at the Nittany Lion Inn was attended by three hundred and eleven persons. A special luncheon for women mathematicians was held in honor of the women who were pioneers in mathematical research in America.

T. R. HOLLCROFT,
Associate Secretary

LECTURES OF THE NEW YORK ACADEMY OF MEDICINE

THE third series entitled "Lectures to the Laity" of the New York Academy of Medicine, of which Dr. James Alexander Miller is president, opened on October 28. The title of the present series is "The Art and Romance of Medicine." The lectures will be given at 8:15 P. M. The program is as follows:

October 28. "From Barber-Surgeons to Surgeons—The Evolution of Surgery as a Profession," Dr. Francis R. Packard, editor of *Annals of Medical History*.

November 24. "The Meaning of Medical Research," Dr. Alfred E. Cohn, member of the Rockefeller Institute for Medical Research.

December 23. "Dr. Watson and Mr. Sherlock Holmes," Dr. Harrison Stanford Martland, professor of forensic medicine, New York University College of Medicine.

January 27. "Medicine in the Middle Ages," Dr. James J. Walsh, extension professor, Fordham University.

February 24. "The Search for Longevity," Dr. Raymond Pearl, professor of biology, the Johns Hopkins University.

March 24. "The Physicists' Contribution to Medicine," Dr. Edward Elway Free, consulting physicist.

April 28. "Medicine and the Progress of Civilization," Dr. Nicholas Murray Butler, president, Columbia University.

May 26. "X-Ray within the Memory of Man," Dr. Lewis Gregory Cole, consulting roentgenologist, Fifth Avenue Hospital.

IN HONOR OF DR. JOHN H. NORTHROP

DR. JOHN H. NORTHROP, of the laboratories of the Rockefeller Institute for Medical Research, Princeton, N. J., was presented with the Charles Frederick Chandler Medal of Columbia University for "fundamental discoveries concerning bacteria, the constitution of proteins, and the chemistry of digestion" on October 27. Following the presentation, Dr. Northrop delivered the fourth in a series of Chandler Memorial Lectures, taking as his subject "The Chemical Nature and Mode of Formation of Pepsin, Trypsin and Bacteriophage." Dean George B. Pegram presided at the presentation ceremony.

The medal was founded in 1910 to honor Professor Chandler, called the father of the American Chemical Society, who was born in 1836 and who for more than half a century was a pioneer in the advancement of public health and in industrial chemistry. He directed the teaching of chemistry at Columbia, where he was a founder of the School of Mines.

The report of the Committee on the Chandler Lectureship Foundation, which nominated the medalist and of which Professor Arthur W. Thomas is chairman, is as follows:

> Dr. Northrop's researches have opened an important road to the investigation of protein constitution and the chemistry of digestion. He was the first to isolate the digestive enzymes, pepsin and trypsin, as well as their respective proferments in crystalline and apparently pure condition. He is also known for his studies of phosphoric acid in starch.
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> His experience made it possible for Dr. W. M. Stanley, of the Rockefeller Institute, to isolate in crystalline form the virus for the tobacco mosaic disease. This crystalline protein may have far-reaching significance in understanding diseases due to different viruses.
>
> His work on fermentation led to the development of a process for the production of acetone and ethyl alcohol, which solved one of the problems connected with the manufacture of war materials.

Dr. Northrop and his father, the late John I. Northrop, of the department of zoology of Columbia University, both studied under Professor Chandler. Dr. Northrop was born in Yonkers, N. Y., on July 5, 1891. He received the bachelor of science degree from Columbia University in 1912, the master of arts in 1913, and the doctorate in 1915. Harvard University conferred upon him the honorary degree of doctor of science during the tercentenary celebration last year. Since 1916 he has been associated with the Rockefeller Institute for Medical Research. He is a member of the National Academy of Sciences, the American Chemical Society, the Society for Experimental Biology and Medicine, the Harvey Society, Sigma Xi, Phi Lambda Upsilon, Delta Kappa Epsilon, the Kaiser Deutsche Akademie der Naturforscher and of the editorial board of the *Journal of General Physiology*.

Previous recipients of the medal include Leo H.

Baekeland, William F. Hillebrand, Willis R. Whitney, F. G. Hopkins, Edgar F. Smith, R. E. Swain, E. C. Kendall, Samuel W. Parr, Moses Gomberg, John Arthur Wilson, Irving Langmuir, James Bryant Conant, George O. Curme, Jr., Jacob Goodale Lipman and William F. Giauque.

SCIENTIFIC NOTES AND NEWS

DR. WILLIAM WEBER COBLENTZ, chief of the section of radiometry of the National Bureau of Standards, has been awarded the Rumford Gold Medal by the American Academy of Arts and Sciences for his work as a "pioneer in the technology and measurement of heat and light."

THE Lavoisier Medal of the Société Chimique de France will be presented by the French Consul General, Comte de Ferry de Fontnouvelle, to Dr. Thomas H. Norton, member of the technical staff of the American Cyanamid Company, at a meeting on November 19 at Columbia University of the American Section of the society, to which members of the American Chemical Society, the American Institute of Chemists, the American Electrochemical Society and the Society of Chemical Industry, American Section, are invited. At this meeting Dr. Francis F. Lucas, member of the technical staff of the Bell Telephone Laboratories, will speak on "Ultra-violet Microscopy."

THE American Academy of Ophthalmology and Otolaryngology presented its medal of honor on October 13, at the meeting in Chicago, to Dr. Harris P. Mosher, of Boston, professor of otology in the Harvard Medical School. Dr. George M. Coates, of the Medical School of the University of Pennsylvania, was chosen president-elect for 1938–39. Dr. Harry S. Gradle, extra-mural professor of ophthalmology in the medical department of Northwestern University, was elected president for the ensuing year. The next annual meeting will be in Washington, D. C.

THE degree of doctor of laws has been conferred by the University of California on Dr. Charles A. Kofoid, professor of zoology emeritus.

AT the fifty-ninth annual Founders' Day exercises at Lehigh University on October 9, the honorary degree of doctor of science was conferred on Dr. William J. Robbins, professor of botany and dean of the Graduate School of the University of Missouri, who was recently appointed director of the New York Botanical Garden and professor of botany at Columbia University; on Hardy Cross, head of the department of civil engineering at Yale University; on Levering Tyson, president of Muhlenberg College, and on Erwin G. Bailey, steam engineer of the Babcock-Wilcox Company.

DR. EMIL ABDERHALDEN, professor of physiology at the University of Halle, has been elected to honorary membership in the Naturforschende Gesellschaft of Danzig.

DR. WALTHER NERNST, of Berlin, and Dr. Max Wien, of Jena, have been elected honorary members of the German Physical Society.

PROFESSOR JOJI SAKURAI, president of the Imperial Academy and of the National Research Council of Japan, has been elected vice-president of the International Council of Scientific Unions in succession to the late Marchese Marconi.

DR. BUFORD JOHNSON, professor of psychology at the Johns Hopkins University, will retire at the close of the academic year.

DR. DOUGLAS JOHNSON, professor of physiography at Columbia University, has been appointed executive officer of the department of geology and mineralogy. Dr. Robert C. Elderfield, formerly assistant professor of chemistry, has been promoted to an associate professorship.

AT the Case School of Applied Science at Cleveland, Kenneth H. Donaldson has been promoted from an associate professorship of mining engineering to a full professorship; Dr. Anatoli C. Seletzky, electrical engineering; Herbert R. Young, English, and Dr. Eric A. Arnold, analytical chemistry, have been appointed to associate professorships.

WILLIAM A. THOMAS, assistant professor of electrical engineering at Antioch College, has been appointed to a similar position in the department of electrical engineering at the Iowa State College.

ASSOCIATE PROFESSORS DAVID VERNON WIDDER and Marshall Harvey Stone, of the Division of Mathematics of Harvard University, have been promoted to full professorships.

MISS ANNA BILLINGS GALLUP, since 1902 curator-in-chief of the Brooklyn Children's Museum, has presented her resignation to the Board of Trustees of the Brooklyn Institute of Arts and Sciences. She will be succeeded by Mrs. William Lloyd Garrison, 3d, assistant to Philip N. Youtz, director of museums for the institute. Mrs. Garrison has worked with Miss Gallup and is known as a writer and lecturer on problems of youth and on Central American ethnology.

R. Y. WINTERS, since 1925 director of the North Carolina Agricultural Experiment Station, has ac-

cepted appointment as principal experiment station administrator in the Office of Experiment Stations of the U. S. Department of Agriculture, as of October 15.

DR. ROY F. FEEMSTER, Boston, has been appointed director of the State Division of Communicable Diseases, succeeding Dr. Gaylord W. Anderson, who resigned recently to become professor of public health at the University of Minnesota Medical School. Dr. Anderson's post as deputy health commissioner will be taken by Dr. Alton S. Pope, in addition to his work as director of the division of tuberculosis.

DR. MAXWELL TISHLER, of Harvard University, and Dr. Jacob van de Kamp, of the University of Virginia, have joined the staff of the Research Laboratories of Merck and Company, Inc.

DR. H. S. TAYLOR, chairman of the department of chemistry at Princeton University, has been added to the group of leading chemists of the country who are studying catalysis under the chairmanship of Dr. Robert E. Burk, of Western Reserve University.

THE Lord President of the British Scientific Research Council has appointed Dr. G. M. B. Dobson, Lieutenant-Colonel J. H. M. Greenly and S. K. Thornley to be members of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research. Professor A. Fowler, Sir Clement D. M. Hindley and T. Franklin Sibly have retired from the council on the completion of their terms of office.

LYNDON F. SMALL, associate professor in chemistry at the University of Virginia and director of the chemical studies under the Committee on Drug Addiction of the National Research Council, has been appointed United States representative on the Opium Assay Commission of the Health Section of the League of Nations, to succeed Dr. Charles H. LaWall. Dr. Small sailed for London on October 13 to attend a meeting of this commission, which was appointed for the purpose of recommending an international method for the assay of opium and coca leaf.

DR. HUGH S. CUMMING, formerly surgeon general of the U. S. Public Health Service, director of the Pan-American Sanitary Bureau, has sailed for Paris, where he will attend the International Health Conference, of which he is the member for the United States. Later he will attend the Health Division of the League of Nations at Geneva.

PROFESSOR BAILEY WILLIS returned recently to his residence, Stanford University, after an absence of a year, during which he visited India, the East Indies, the Philippines and Japan. His objective was a study of mountain building during Tertiary and Pleistocene time. Contacts were established with English, Dutch, Philippine and Japanese geologists with a view to continued exchange of data, it being anticipated that the results may eventually be published in a monograph, a sequel to "African Plateaus and Rift Valleys."

DR. C. T. BRUES, professor of entomology at Harvard University, has returned from a five months' trip to the Dutch East Indies, visiting in company with Mrs. Brues the islands of Celebes, Java and Sumatra. They went primarily to investigate the fauna of the hot springs of this region, but in addition to collections of insects and plants secured also a large number of motion pictures and photographs.

DR. ISAIAH BOWMAN, president of the Johns Hopkins University, was the principal speaker on October 25 at a dinner given at the Commodore Hotel to initiate the United Hospital campaign fund.

DR. KIRTLEY F. MATHER, professor of geology at Harvard University, spoke on October 18 before the Clark University Scientific Society and Sigma Xi Club. His topic was "The Geologist in Prophetic Mood."

DR. L. H. BAEKELAND delivered on October 20 the first lecture of a series to be given during the autumn and winter months at the Franklin Institute, Philadelphia.

THE Edward K. Dunham Lectures for the promotion of the medical sciences will be given under the auspices of the faculty of medicine of Harvard University by Dr. Corneille Heymans, professor of pharmacology at the University of Ghent, on November 8, 10 and 12 at 5 o'clock. The title of the first two lectures is "The Mechanisms of Vasomotor Tone and Blood Pressure Regulation"; and the third, "The Rôle of the Aortic and Carotid Sinus Presso- and Chemoreceptors in the Reflex Control of Respiration."

DR. THE SVEDBERG, professor of chemistry at the University of Upsala, who is visiting the United States, lectured on October 18 at Goucher College on "Blood Serum—Its Normal and Pathological Protein Constituents," and on October 25, at a meeting of a colloquium of the Bell Telephone Company, he spoke on "The Ultracentrifuge and its Field in Research."

DR. CARL G. JUNG, professor of analytic psychology at the Federal Polytechnic University at Zurich, Switzerland, gave on October 20, 21 and 22 a series of three public lectures on "Applied Psychology and Religion" on the Terry Foundation of Yale University.

SEVERAL Benjamin Peirce instructorships at Harvard University for the year 1938–39 are open to men who have the degree of doctor of philosophy or its equivalent. Applications should be sent to the chairman of the Division of Mathematics.

Museum News states that a museum has been opened in the old ship-chandlery over the water at

Hog Island, in Muscongus Bay, Maine. The museum was set up by students of the Audubon Nature Camp for Adult Leaders opened in the summer of 1936 by the National Association of Audubon Societies. It contains exhibits illustrating life histories, rare living marine organisms, calendar of birds observed, biological family trees, herbarium specimens, etc. Hog Island forms the Todd Wild Life Sanctuary, preserved largely in primitive condition through the efforts of the family of Millicent Todd Bingham and placed by her under the control of the Audubon Societies. Carl W. Buchheister is director of the camp, which was open this year from June 11 to September 2.

THE *Journal* of the American Medical Association reports that the Rockefeller Foundation will aid in financing a survey on malaria in Escambia County, Florida, with Dr. John E. Elmendorf, Jr., of the foundation, in charge of headquarters in Pensacola. Of the $8,000 to be spent for the first year's work, the city and county will each pay $1,000. It is expected that the control areas will be selected on the basis of the intensity of malaria existing in the district, the adaptability of the local problem to different types of malaria control and the local interest shown in the solution of the problem. Dr. Elmendorf will also be director of a malaria division to be formed in the Escambia County health department.

Museum News reports that the Buffalo Museum of Science this fall resumes a number of its services that had been temporarily discontinued on account of reduced budget. The resumption is made possible by an appropriation from the city of $110,000 for the year. Last year the city's contribution was $60,000. The museum will be open 56 hours a week instead of 22. Evening openings three times a week and evening classes, lectures and similar discontinued services will be resumed. The Kellogg Observatory will be open again, and the museum training course will be given again this season. The museum has also received a grant of $50,000 from the Rockefeller Foundation for carrying on for three years a plan of museum interneship. Two-year appointments are given to museum workers in anthropology, biology and the physical sciences (two in each field).

Nature writes that besides the usual statistical information regarding the number of visitors and attendances at lectures, notes on special exhibitions, on acquisitions and the progress of the five main divisions of the museum, the annual report of the Advisory Council of the Science Museum for 1936, London, contains a review of the growth and activities of the library, which is being developed as a National Library of Science. During the year, the library was used by 22,000 readers, while the issues on loan of books and periodicals to government departments, scientific and technical societies, colleges, etc., was 21,000. The library receives more than 9,000 current periodicals and the contents of these are all indexed, references to these and to other matters now running into millions. There are about 250,000 books in the library. The two main functions "may broadly be stated as the acquiring of documents and making them readily available," the latter consisting of cataloguing the volumes, maintaining indexes of their contents, provision of the volumes to readers, loan service, supply of bibliographies, supply of photostat copies and library publications. There have been many valuable additions to the collections in the museum, and during the year under review special exhibitions were arranged illustrating the progress of research at very low temperatures, the scientific aspects of smoke pollution of the atmosphere and the developments in electric illumination.

AN enabling act, whereby a state soil conservation committee and farmers may take group action for control and prevention of soil erosion, which was passed at the last regular session of the Maryland Legislature, has been signed by Governor Nice. This act had the endorsement of the Farm Bureau and State Grange and provides for establishment of local districts and authorizes acceptance of Federal funds to be administered by supervisors that are elected or appointed locally in furthering the work in such districts. The state soil conservation committee provided in the act consists of the president of the State Board of Agriculture, the directors of the Agricultural Experiment Station and Extension Service, the Maryland State Forester and the principal state administrative officer for this state of the Soil Conservation Service, United States Department of Agriculture.

THE fiftieth annual meeting of the Geological Society of America will be held on Tuesday, Wednesday and Thursday, December 28 to 30, in Washington, D. C., under the auspices of the Geological Society of Washington. Dr. Charles Palache, professor of mineralogy at Harvard University, is president. The headquarters, the place of registration, the scientific sessions and the exhibits will be held in the Hotel Washington. The regular dinner of the society will be held on Wednesday evening, December 29. Simultaneously with the meeting of the Geological Society, the Paleontological Society will hold its twenty-ninth annual meeting, *Secretary,* B. F. Howell, Princeton University, Princeton, N. J.; the Mineralogical Society of America its eighteenth annual meeting, *Secretary,* Paul F. Kerr, Columbia University, and the Society of Economic Geologists its seventeenth annual meeting, *Secretary,* D. H. McLaughlin, Rotch Building, Cambridge, Mass.

DISCUSSION

THEORY OF PROTOPLASMIC STREAMING

PROTOPLASMIC movement is now recognized as a general and fundamental property of metabolically active cells. It has risen to this position from the controversial one held not many years ago when the streaming of protoplasm was looked upon by some physiologists as a pathological condition in opposition to the view that it is evidence of a normal and healthy state.

The force responsible for protoplasmic flow has been the subject of much lively and stimulating speculation. My earliest memory goes back to the days when surface tension, the *sine qua non* of so many cellular activities, was regarded as the energy source of protoplasmic streaming. There was also the suggestion that the one-way "shuttle" type of flow in the filaments of coenocytes, where movement is first in one direction and then in the other, may be due to hydration at one end and dehydration at the other end; but the protoplasm flows equally well in both directions, even when fully submerged. Obviously, dehydration can play no part.

Physiology next entered the colloidal epoch when it became apparent that many cellular activities had their counterpart in colloidal systems. There thus arose the suggestion that protoplasmic streaming is a cataphoretic migration of particles or the electro-endosmotic flow of an aqueous medium; if either, it is the latter, for in streaming protoplasm the entire mass of material moves and not just the suspended particles. In spite of some attempts to prove that streaming protoplasm is associated with electric potentials, there has been no convincing evidence that the potentials measured are real, in the sense of innate to the protoplasm, and if real, are the cause rather than the result of the streaming. Most electrical determinations made on cells and tissues are subject to the criticism that the potentials measured may not reside in the living material alone, but are produced by the experimental equipment as a whole. This statement is in no way intended to deny or question the existence of electric potentials in organisms; on the contrary, all necessary conditions for the production of potentials are present, but do the potentials measured exist in the living material?

Should the source of energy responsible for protoplasmic streaming be found, there would still remain the question, why the direction of flow reverses in the shuttle type of streaming. The protoplasm of slime-molds flows but one way at a time. Were a potential responsible there would have to be a reversal of it every forty or fifty seconds, and so the problem takes on a two-fold aspect—why the streaming, and why the reversal?

The slime-molds, or myxomycetes, sometimes referred to as mycetozoa, possess a body or plasmodium which is a non-cellular protoplasmic mass with ever-shifting channels of flow. A brief study of slime-mold plasmodia is sufficient to suggest the presence of a nearly perfect rhythm in the reversal of direction of flow. The average of many time records gives forty to fifty seconds for each period of flow. The minimum time is twenty seconds, and the maximum sixty between reversals. (The average maximum rate of flow is 0.07 mm per second.) The foregoing limits in time of flow suggest a lack of rhythm, but most often the periods of flow vary little from the mean. Pronounced divergences from the average of forty-five seconds are to be attributed in part to physiological disturbances in an artificially mounted specimen of plasmodium.

My own motion pictures of slime molds had all been taken at moderately high magnification and at normal speed. I therefore failed to see the essential feature of the rhythm. This first became obvious to me on viewing the excellent cinematographs of slime-molds taken by Drs. J. Comandon and P. de Fonbrune, of the Pasteur Institute at Garches, France. My visits to these laboratories have always been profitable. The first films of slime-mold plasmodia by Dr. J. Comandon and Professor P. E. Pinoy were made as long ago as 1912.

When the moving-picture of a small plasmodium is taken at one hundredth of the normal speed and projected at the customary rate, the entire plasmodium is seen to go through rhythmical contractions and expansion similar to the pulsation of a heart. At each contraction, the direction of flow reverses. The mechanism of protoplasmic movement in slime-molds is, then, one of rhythmical contraction and relaxation of the plasmodium as a whole, with a period of 40 or 45 seconds for each pulsation.

If the area covered by a plasmodium, or a branch of it, is noted with the aid of a micrometer, it will be seen that the plasmodium contracts with outgoing protoplasm and expands with incoming protoplasm. I had interpreted this swelling and shrinking as the result instead of the cause of streaming. Contraction is not due to the exit of fluid, and expansion to its entrance, but on the contrary, as in the case of the heart, the exit and entrance of fluid are due to the contraction and expansion of the living substance.

The beat of the heart is controlled by a sympathetic nervous system. There is no nervous system in the sense of nerve-centers and nerve-fibers in slime-molds, but these are not necessary in order to have response and control.

Some modern workers are inclined to strip protoplasm of all the attributes of higher organisms, for-

getting that many of these attributes exist because they are properties of protoplasm. The tendency to regard the protoplasm of more primitive forms of life as less intricate, less responsive, if not "less living" than that in more highly developed forms is evident in such statements as, "there is considerable objection to the use of the word 'injure' in reference to plants." I recall the delightfully courteous remark of the English chemist, H. R. Proctor, who, finding my mechanistic interpretations of protoplasmic behavior rather harsh, asked if he might not still be allowed to regard life as, so to speak, a new departure.

In my turn, I ask the reader merely to admit that protoplasm is alive, for in so doing he tacitly grants that it exhibits irritability, in other words, nervous response.

It is interesting to contemplate the possible relationship between the rhythmical pulsations responsible for protoplasmic streaming in myxomycetes and the rhythmical contraction of sympathetically controlled muscle-tissue.

WILLIAM SEIFRIZ
UNIVERSITY OF PENNSYLVANIA

IN-VITRO SYNTHESIS OF LACTOSE

RECENT work by Graham and Turner, working with goats, and the undersigned, working with dairy cattle, have shown that the active mammary gland removes lactic acid from the blood. The inactive mammary gland does not remove lactic acid. The quantity of lactic acid removed from the blood is such that lactic acid was suspected of being concerned with the synthesis of lactose in the milk. Galactose, which with glucose forms the lactose molecule, can theoretically be accounted for by the condensation of two molecules of lactic acid.

Proof of the correctness of the hypothesis that lactose is synthesized from lactic acid and glucose would lie in in-vitro synthesis of lactose from lactic acid and glucose. Solutions of glucose with lactic acid and various salts of lactic acid were prepared, to which was added macerated mammary gland tissue from lactating cows. This was incubated under toluene at 37° C. The mammary gland tissue was squeezed in muslin bags before and after grinding to express, in so far as possible, the milk retained in the ducts and aveoli. Blanks containing only mammary gland tissue and water incubated simultaneously with the experimental lots showed but the faintest traces of lactose.

Positive proof of the synthesis of lactose was established by the formation of lactosazones and by the isolation of 847 milligrams of material shown to be lactose.

Heating concentrated solutions of lactic acid or salts of lactic acid with glucose also produced lactose as indicated by osazones.

W. E. PETERSEN
J. C. SHAW
UNIVERSITY OF MINNESOTA

THE USE OF MUCUS BY MARINE PLANKTON FEEDERS

WITH the exception of the crustacea, and perhaps the protozoa and sponges, apparently *all* the marine plankton feeders make use of mucus to entangle the microscopic materials upon which they live. This fact seems to have been overlooked by zoologists in general. After many years of study and reference work I have found that the rôle of mucus as an essential part of the feeding mechanism of marine animals has been greatly underestimated.

In 1928 I described the feeding habits of the gephyrean, *Urechis caupo,* in joint papers with Dr. W. K. Fisher,[1, 2] in which he gave the classification and description of the worm. At that time this method of feeding was considered unique by those biologists who became acquainted with the paper; but I have since found that this method is not unique, for other animals use a similar method of entangling their food, for example, *Chaetopterus variopedatus* and the tunicate *Diplosoma macdonaldi.* In the case of many other animals in which the cilia have been credited with the selective function of obtaining food, I have found that the mucus forms a plate through which water is strained, and actually the cilia furnish only the mechanical power for creating the currents. One reason why mucus has not heretofore been accredited with its important rôle is that it is perfectly transparent, unless heavily laden with food; and another reason is that investigators have used such materials as carmine, India ink, etc., which, in most cases, cause a cessation of the secretion of mucus. Hence, what the investigators have done is to make plots of the ciliary currents, which often were reversed from what they actually are during feeding operations.

I have found that the method of feeding in *Chaetopterus* is by the secretion of a slime bag or funnel through which all water entering the burrow during feeding passes. As the bag is being secreted at the top by the aliform notopodia, it is rolled into a ball at the bottom by the accessory feeding organ; but at intervals secretion of slime ceases and this food ball is passed forward to the mouth, after which a new slime bag is formed. Therefore, the actual operation of food getting by *Chaetopterus* is quite different from that described by Enders,[3] whose paper is by far the

[1] W. K. Fisher and G. E. MacGinitie, *Ann. Mag. Nat. Hist.*, ser. 10, Vol. 1, pp. 204–213, 1928.
[2] *Ibid.*, Vol. 1, pp. 199–204, 1928.
[3] H. E. Enders, *Jour. Morph.*, 20: 3, 479–532, 1909.

most complete of many written on the natural history of this worm. It exemplifies a case in which mucus was overlooked in attempting to determine the feeding method of a plankton feeder.

A slime net is as efficient as any structure that one may imagine, for, though a dye in solution will pass through it as though it were not there, the slime net will entrap the smallest particles which are visible by the aid of an oil immersion lens. With bottom feeding forms this microscopic material consists in large part of bacteria. In SCIENCE, 1932,[4] I gave an account of a successful feeding experiment in which a pure culture of bacteria was used by a mud flat animal, and it is difficult to think of any structural device other than such a mucus net which would screen bacteria from water. The abundance and availability of marine bacteria for food have since been confirmed by ZoBell and Anderson[5] and other marine bacteriologists.

Apparently little is known of the chemical composition of mucin, particularly in the lower animals, and I believe nothing is known of its physical characteristics. A detailed account of the use of mucus by plankton feeders is in the process of preparation and should be ready for publication within the next year.

G. E. MACGINITIE
KERCKHOFF MARINE LABORATORY,
CALIFORNIA INSTITUTE OF TECHNOLOGY,
CORONA DEL MAR, CALIF.

DIET AND RESISTANCE TO COLDS

SPIESMAN and Arnold recently[1] reported their observation that carbohydrate restriction reduces the incidence of colds, and they pointed out that Paton[2] and Orr and Gilks[3] made similar observations. I recently[4] also had occasion to refer to previous reports on this subject made by McQuarrie[5] and Higgins[6] as well as by Paton and by myself.[7] However, Spiesman and Arnold state that they have no explanation to offer for the beneficial results obtained by carbohydrate restriction, although McQuarrie, Higgins and I attributed the benefits to a reduction in tissue hydration. Adlersberg and Porges[8] likewise noted the dehydrating effect of a low carbohydrate diet and found that it can be employed with good success not only in edemas of various origins but also in inflammatory exudates, for limitation of the quantity of sputum in bronchiectasis and, finally, as an "antiphlogistic diet" in certain inflammatory processes."[9] Before this, Glasscheib[10] advocated the use of acid salts and vitamin D to reduce hydration for the control of vasomotor rhinitis. Glasscheib, however, distinguished between vasomotor rhinitis and common colds, which he still[11] believed were due to infection and not preventable by a dehydrating regimen. Nevertheless, Glasscheib's ideas are pertinent to the subject in view of the fact that Speisman and Arnold emphasize the rôle of vasomotor responses in susceptibility to upper respiratory infections.

FREDERICK HOELZEL
CHICAGO, ILL.

CORRELATION OF RIVER TERRACE REMNANTS

RIVER terrace remnants have been correlated on the basis of their absolute elevations as obtained by approximate or precise measurement. Such correlation involves the assumption that the relief of the ancient flood-plain from which the terraces were derived was negligible.

Geomorphic studies[1] of flood-plains of present-day rivers show that the magnitude of their relief may often be sufficient to throw doubt on such correlations. It can be demonstrated, for example, that two terrace remnants differing seventy-five feet in their relative elevation may represent portions of the same ancient surface of deposition.

Typical flood-plains are normally diversified by such features as bars and swales, abandoned channels, natural levees of the main stream and its tributaries, meander scars and minor depositional features. This multiplicity of possible forms and their occurrence spatially in any order produce a terrain of unpredictable irregularity. Upon this terrain unadjusted tributaries may deposit alluvial fan material of varying thickness and extent.

It is apparent that the maximum relief of the flood-plain, excluding effects due to deposition by lateral tributaries, is limited, though not necessarily determined, by the maximum possible range of the major water plane. An examination of large-scale contour maps showing details of flood-plains of several major rivers has established the fact that the absolute relief, as measured from the low-water surface of the master stream, may exceed fifty feet and often averages twenty-five feet. In the case of small graded streams

[4] G. E. MacGinitie, SCIENCE, 76: 1978, 490, 1932.
[5] Claude E. ZoBell and D. Quentin Anderson, *Bull. Am. Assoc. Petrol. Geol.*, 20: 3, 258–269, 1936.
[1] *Am. Jour. Dig. Dis. and Nutrition*, 4: 438, 1937.
[2] *Brit. Med. Jour.*, 1: 738, 1933.
[3] Med. Research Council. Special Report No. 155, 1931.
[4] *Jour. Amer. Med. Assoc.*, 108: 2156, 1937.
[5] *Jour. Nutrition*, 2: 31, 1929.
[6] *New England Jour. Med.*, 203: 145, 1930.
[7] *Proc. Soc. Exp. Biol. and Med.*, 25: 454, 1928, and SCIENCE, 68: 301, 1928.
[8] *Klin. Wochenschr.*, 12: 1446, 1933.
[9] Quoted from abstract in *Jour. Amer. Med. Assoc.*, 101: 1766, 1933.
[10] *Monatschr. f. Ohrenheilkunde*, 62: 168, 1928.
[11] Personal communication, dated November 26, 1928.
[1] Pursued as a university fellow of Columbia University, in consultation with Professor Douglas Johnson.

so high a relief will not be attained, for the magnitude of the relief will be found roughly proportionate to the size of the master stream.

The deposition by unadjusted tributaries at their débouchement has an important local influence upon the relief of the flood-plain. Along the flood-plain borders alluvial fans, which may be closely spaced, sometimes accentuate the relief by more than sixty feet. The extent and thickness of these fans are usually not closely related genetically to the size and development of the main stream; hence large fans may accumulate upon narrow flood-plains. Because of their low angle of slope and fairly large areal extent these deposits are but difficultly recognizable in the field, a rise of forty or fifty feet in one or more miles being scarcely noticeable.

From the foregoing, it follows that before the investigator of river terraces can assign any particular terrace remnant to a postulated ancient surface of deposition, he must consider, among other things, whether the remnant which he is studying may represent (1) some portion of the surface of a broad alluvial fan, a portion perhaps sixty or more feet above the normal level of the ancient flood-plain; (2) an interfan area, which itself may have been part of a natural levee, an abandoned channel, a bar, a swale or some other feature of the complex surface called the "flood-plain," embracing a possible difference in relief of more than fifty feet.

DAVID ST. CLAIR

COLUMBIA UNIVERSITY

SPECIAL CORRESPONDENCE

INTERNATIONAL ENCYCLOPEDIA OF UNIFIED SCIENCE

RECENT years have witnessed a striking growth of interest in the scientific enterprise as a whole and especially in the unity of science. The concern throughout the world for the logic of science, the history of science and the sociology of science reveals a systematic tendency to consider science as a whole in terms of the scientific temper itself. A science of science is appearing. This is an indispensable corrective of the extreme specialization of scientific research. It is an urgent task of science to work out the synthesis of its results and methods. Otherwise science will not have carried to its limit the fulfilment of its own task as science, nor will it perform adequately its educational rôle in the modern world.

The unity of science movement has found an organized contemporary expression in the International Congresses for the Unity of Science, administered by an international committee composed of the following persons: N. Bohr, M. Boll, H. Bonnet, P. W. Bridgman, E. Brunswik, R. Carnap, E. Cartan, J. Clay, M. R. Cohen, J. Dewey, W. Dubislav, F. Enriques, P. Frank, M. Fréchet, F. Gonseth, J. Hadamard, P. Janet, H. S. Jennings, J. Joergensen, E. Kaila, H. Kelsen, T. Kotarbinski, A. Lalande, P. Langevin, K. S. Lashley, C. I. Lewis, J. Lukasiewicz, G. Mannoury, R. von Mises, C. W. Morris, O. Neurath, C. K. Ogden, J. Perrin, H. Reichenbach, A. Rey, C. Rist, L. Rougier, B. Russell, L. S. Stebbing, J. H. Woodger.

Three such congresses have been held, and preparations are now being made for a congress to be held at Harvard University from September 5 to 10, 1939. This congress includes among its sponsors the American Association for the Advancement of Science, the Association for Symbolic Logic and the American Philosophical Association. The theme will be "Logic of Science."

For some time it has been felt that a systematic expression of the point of view and results of the unity of science movement was necessary. This need has led to the development of a plan for the publication of an "International Encyclopedia of Unified Science." The general purpose of this work is to bring together material pertaining to the scientific enterprise as a whole. Its task will not be to present the detailed results of the special sciences but rather to stress the logical structure of the special sciences considered in relation to one another. The Encyclopedia will therefore be concerned with the development of a unified scientific language; with problems concerning the logical analysis of, and correlations between, concepts and fundamental principles of the various sciences; with questions of scientific procedure; and with the various senses in which science may be considered a unified whole. Treatment of these fundamental matters will be supplemented by presentations of the history of scientific thought, the sociology of science, the newer logical techniques and the general theory of signs. It is planned to show explicitly gaps in the system of knowledge and questions which still remain open; where agreement has not been reached, divergent opinions will be presented side by side.

The wish to insure impartiality has led to a selection of collaborators with somewhat different points of view, but who agree in considering the unity of science as the ideal aim of their efforts, in eliminating any form of speculation other than that recognized in science, in stressing the importance of logical analysis in various fields, and in taking into account the historical development of scientific concepts and regulative prin-

ciples. Such collaborators include, for instance, persons stemming from the Vienna circle, from the Berlin group of scientific philosophers, from the Polish school of logicians, from the group centering around *Scientia* and the *Centre de Synthèse*, as well as representatives of American pragmatism, the English analytical school, French conventionalism, various groups of scientific philosophers in Belgium, Holland, Switzerland, Denmark, Sweden and other countries, and a large number of scientists from the various special branches of science.

For these and other reasons there will be a certain divergence of opinions within the wider set of agreements which give unity to the work; tendencies which are often called scientific empiricism and logical empiricism will find a place by the side of other tendencies which prefer to be called scientific or experimental rationalism. Collaborators of various nationalities have been invited; only their personal competence has been considered or the benefits to be obtained from a variety of cultural view-points—their political views or the political ideologies of the countries they represent have not come into consideration, since the Encyclopedia is a scientific and not a political enterprise. Each collaborator will, of course, be responsible only for the ideas which he himself expresses.

The subjects chosen will insure that the total series of contributions will form a systematic whole dealing with all the main fields of science and with all the types of consideration which the existence of science provokes. The monographs will be intelligible to the person of a scientific habit of mind interested in the whole range of science. The Encyclopedia is not designed to popularize science or to compete with the existing type of scientific encyclopedia. It is believed that the general educational implications of the unity of science movement are important, but the immediate aim of the proposed work is rather to reach those persons upon whom the future of science depends and to stress those matters which existing encyclopedias of science neglect.

As a means of launching the project of an "International Encyclopedia of Unified Science," there is to be published by the University of Chicago Press a series of short monographs or pamphlets, twenty in number, which will serve as introductions to all the main fields which are to be represented in the Encyclopedia. This series of pamphlets taken as a whole will constitute the first two introductory volumes of the Encyclopedia, but will be issued as an independent and completely self-contained unit under the title of "Foundations of the Unity of Science."

It is to be hoped that scientists as well as those interested in the institution of science will make the Encyclopedia project and the International Congresses for the Unity of Science their own. The most concrete form of aid at the moment toward realizing the larger project of the Encyclopedia is to subscribe to these independent volumes, "Foundations of the Unity of Science."

ENCYCLOPEDIA COMMITTEE OF ORGANIZTION,
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PHILIPP FRANK
JOERGEN JOERGENSEN
CHARLES W. MORRIS
OTTO NEURATH
LOUIS ROUGIER

SCIENTIFIC BOOKS

MARCONI

Marconi the Man and His Wireless. By ORRIN E. DUNLAP, JR. The Macmillan Company, New York, $3.50.

IN his latest book, the radio editor of *The New York Times* has presented an interesting and timely biography of one of the most constructive workers of our age. Marconi was always an attractive figure to Americans, for, like Henry Ford, the public felt that he had attained personal eminence and affluence through originality, daring and hard work. These qualifications, at least in the past, were the "camel's eye" through which even wealth might be admitted to the heaven of good repute.

Mr. Dunlap has most painstakingly searched the record for data relative to the career of Marconi, and the results attest to his thoroughness. If the book is occasionally chatty, discursive and verging on hero worship, it is not unnatural that in so full a compendium, Marconi's aims, ambitions, reactions and recognition should have loomed large before the biographer. A mountain in the foreground can block out an entire mountain range and stand in vast and horizon-shadowing perspective.

Mr. Dunlap, nevertheless, is careful to give numerous quotations giving full credit to the pure scientists, Maxwell and Hertz, who made possible the work of Marconi, and as well many later workers who will follow in their steps. Maxwell first gave us the concept of the electromagnetic wave, and to this day the problems of its production and propagation over the earth are only partly understood. The physical existence of surface and space waves is still sharply debated among radio scientists. Hertz first taught us how to transmit and receive these waves. The Hertz-

ian transmissions were on extremely high frequencies producing the so-called ultra-short waves. It is again curious that we should have closed a cycle. The first waves used for communication were hundreds or thousands of times longer than those which Hertz produced. Gradually long-distance communication came back to the short waves. And to-day television conditions require our return to ultra-short waves. From Hertz to television seems a long cycle, and yet this is another instance where pure research first produced the agency which, generations later, was both needed and available.

Mr. Dunlap properly emphasizes the position of Marconi as a sort of bridge between the rudimentary foundations of electromagnetic wave technique and our present evolved and complicated radio art. He makes it clear, however, that Marconi was far from a passive medium. His personal bravery and tenacity, combined with scientific thoroughness and faith in technical development, led Marconi step by step from the rôle of the world's first radio amateur to a position as its leading radio engineer.

As Mr. Dunlap indicates, it is difficult for us to evaluate fairly the contributions of Marconi, since we are too close to some of them and have only inklings of others. So far as radio telegraphy and telephony are concerned, we have a fair idea of the outstanding character of Marconi's contribution. In the nascent arts of radio facsimile and television transmissions, we can not clearly view the vortex of progress in which we whirl. In more remote applications of radio technique, as, for example, meteorological studies, we have only a foreshadowing of what Marconi's work on short-wave transmission may ultimately mean.

We have learned much of the electrical constitution of the upper atmosphere by radio methods—and as Mr. Dunlap points out, the short wave experiments of Marconi here blazed a trail the ultimate significance of which few have appreciated.

It may be added that Marconi is presented as a prepossessing modest personality, never losing touch with humanity and the common things of everyday life. The major premise of the book, which is fully proven, is that men of the type of Marconi and his predecessors are beacons lighting the world toward what may be brighter days and constituting constructive forces in an age too prone to the destruction of human values.

ALFRED N. GOLDSMITH

SPECIAL ARTICLES

JAPANESE B ENCEPHALITIS VIRUS: ITS DIFFERENTIATION FROM ST. LOUIS ENCEPHALITIS VIRUS AND RELATIONSHIP TO LOUPING-ILL VIRUS

WHEN St. Louis encephalitis was first recognized in 1933, it was likened both clinically and epidemiologically to summer encephalitis B of Japan.[1] Later, however, when the St. Louis virus agent was discovered and established in mice,[2] it proved to be neutralized specifically by sera of St. Louis but not Japanese convalescents.[3] Now, within the past two years, the virus agent of the Japanese disease has been established in mice[4] and found by repeated cross serological and resistance tests to be immunologically distinct from the St. Louis virus.[5, 6]

Moreover, the reactions of the two viruses in animal species prove to be readily distinguishable. The St. Louis virus is pathogenic apparently only for mice and *Macacus rhesus* monkeys. Mice injected with the virus usually show as a first sign of disease tremors and convulsions, fail to show virus regularly in the blood stream, and are resistant to intraperitoneal or subcutaneous injections of all save maximum doses. Monkeys injected intracerebrally with massive doses are relatively resistant, less than 50 per cent. showing a mild, non-fatal encephalitis. Japanese virus, on the other hand, is pathogenic for mice, *Macacus rhesus* monkeys and sheep. Mice injected with the virus generally show paralysis of extremities as a first sign of disease, carry virus in the blood stream during the early stages of infection, and are relatively susceptible to intraperitoneal or subcutaneous injections. Monkeys given an intracerebral injection of a small quantity of virus develop an acute, fatal encephalitis characterized by cerebellar incoordination and specific necrosis of the Purkinje cells. Sheep injected intracerebrally or intranasally develop an acute, fatal encephalitis but appear resistant to subcutaneous injection.

[1] J. P. Leake, *Jour. Am. Med. Assn.*, 101: 928, 1933; 103: 728, 1934.

[2] L. T. Webster and G. L. Fite, SCIENCE, 78: 463, 1933; *Jour. Exp. Med.*, 61: 103, 411. 1935.

[3] L. T. Webster and G. L. Fite, SCIENCE, 79: 254, 1934; *Jour. Exp. Med.*, 62: 827, 1935.

[4] The first reports in Japanese journals are cited in later publications by S. Kasahara *et al.*, Kitasato Arch. *Exp. Med.*, 13: 48, 248, 1936; H. Hashimoto *et al.*, *Jour. Am. Med. Assn.*, 106: 1266, 1936; T. Taniguchi *et al.*, *Jap. Jour. Exp. Med.*, 14: 185, 1936; R. Kaneko *et al.*, *Klin. Woch.*, 15: 674, 1936; R. Kawamura *et al.*, *Kitasato Arch. Exp. Med.*, 13: 281, 1936.

[5] R. Kawamura *et al.*, *Kitasato Arch. Exp. Med.*, 13: 281, 1936; *Arch. Path.*, 22: 510, 1936; M. Kudo *et al.*, *Jour. Immunol.*, 32: 129, 1937; Y. Kawakita, personal communication.

[6] Unpublished tests on six Japanese strains by the author.

These reactions of Japanese virus in animal species, while differing sharply from those of St. Louis virus, are indistinguishable from those of louping-ill virus.[7] Serologically, however, Japanese B and louping-ill viruses appear unrelated.

Present knowledge indicates, therefore, that St. Louis and Japanese B encephalitis viruses, and hence the two diseases, are distinct. Japanese B and louping-ill viruses, however, are very similar to each other and also to the virus of Australian X disease as described.[8] Accordingly, possible relationships among louping-ill encephalitis of sheep in Scotland, apparently transferable to man,[9] Japanese summer encephalitis of man and Australian X disease should be further explored.

LESLIE T. WEBSTER

LABORATORIES OF
THE ROCKEFELLER INSTITUTE
FOR MEDICAL RESEARCH,
NEW YORK, N. Y.

DIETARY CONTROL IN EXPERIMENTAL COCCIDIOSIS

THERE is no effective control known for coccidiosis except stringent sanitary measures based upon an understanding of the life cycle of the protozoon. For a number of years the writer has been investigating the possible relation of diet to certain aspects of coccidian infection, particularly in the white rat. Recently efforts have been made to construct rations for the chick that would ameliorate the severity of caecal coccidiosis occasioned by *Eimeria tenella*, which seems to be by far the most virulent of the types found in this bird. Only three of the most striking experiments will be reported here in brief, but a completer report of the experiments will appear later.

One lot of control chicks was kept on a commercial ration that it had received from time of hatching. The ration was 40 per cent. yellow corn-meal, 30 per cent. wheat flour middlings, 5 per cent. ground hulled oats, 5 per cent. powdered skim-milk, 5 per cent. wheat bran and 15 per cent. various amounts of salt, cod liver oil, oyster shell, meat and bone meal, alfalfa meal, bone meal and charcoal. Another lot was given the same mixture until it was fourteen days old, when it commenced to receive the following test mixture: yellow corn-meal, 25 parts; meat and bone meal, 6; soybean meal (with nutty flavor), 22.5; hulled oats, 20; ground wheat, 10; wheat bran, 5; ground oyster shell, 1; salt, 1; charcoal, 1; beet sugar, 6.5; cod liver oil, 2. After nine days on the test ration, both controls and tests were infected with 50,000 sporulated oocysts of *Eimeria tenella* per bird. As a result of this infection nine out of eighteen controls succumbed, but only one out of thirteen in the test series.

One lot of chicks was maintained throughout on the control ration previously described. Another lot received the same until it was eight days of age, when its diet was changed to the following, by parts: yellow corn-meal, 32; hulled oats, 20; soybean meal (the kind with nutty flavor), 16; fish meal, 65 per cent. protein, 4; meat and bone meal, 4; wheat bran, 5; wheat flour middlings, 10; oyster shell, 2; alfalfa meal, 2; commercial casein, 1; salt, 1; charcoal, 1; cod liver oil, 2. After the second lot had been on the test diet for fourteen days, each bird in both lots received 60,000 *Eimeria tenella* oocysts. As a direct result of this infection nineteen out of twenty-four control birds succumbed, but only one out of twenty-four in the test series.

The two preceding test rations were constructed with the idea of eliminating powdered skim-milk and butter-milk altogether from the ration and reducing the amount of wheat flour middlings well below that in the control diet. Certain previous experiments had led us to suspect that these materials in certain combinations, particularly the skim-milk and butter-milk, were the chief inciters of ill effects in infected chicks. The chicks made good gains on both test diets, but four on the second test diet developed a partial paralysis of the type in which the toes turn inwards. They recovered within two days when placed on the control ration again. Since skim-milk has been shown to be a preventative for this type of paralysis, and since the second ration was shown to be slightly deficient in the paralysis-causing factor, a ration was constructed in which a small amount of skim-milk was included and the grain element somewhat varied. It was, by parts, as follows: yellow corn-meal, 40; hulled oats, 10; ground whole oats, 5.5; barley, 5; ground whole wheat, 5; wheat bran, 5; wheat flour middlings, 5; soybean meal, 10.5; meat and bone meal, 4; fish meal (65 per cent. protein), 2; oyster shell, 2; salt, 1; skim-milk, 2; alfalfa meal, 3.

The chicks put on the latter ration at the age of thirteen days made excellent growth during the next fourteen days. At the end of this time twenty-eight chicks on the control ration and thirty-three on the test ration were each given a forced feeding of 80,000 sporulated oocysts of *Eimeria tenella*. As a result of this infection seventeen chicks on the commercial or control ration succumbed, or about 60.7 per cent. There were only six fatalities in the group on the test diet, a mortality of only 18.7 per cent. No paralysis appeared in this group.

These and other experiments by the writer prove that coccidiosis is a disease controllable through the diet. It appears that the extreme severity manifested

[7] W. A. Pool, *Proc. Roy. Soc. Med.*, 27: 707, 1934; E. W. Hurst, *Jour. Comp. Path.*, 44: 231, 1931.

[8] J. R. Perdrau, *Jour. Path. and Bact.*, 42: 59, 1936.

[9] T. M. Rivers and F. F. Schwentker, *Jour. Exp. Med.*, 59: 669, 1934.

in certain outbreaks is attributable not only to the microorganism, but also to certain of the materials incorporated into the ration to stimulate growth of the bird. Powdered skim-milk and buttermilk in certain formulas for chick rations seem to be the most flagrant offenders in this regard. Too many wheat middlings are under suspicion also. The cardinal problem in coccidiosis control is to construct a ration that is adequate in vitamin and vitamin-like materials for the normal development of the host, but at the same time lacks inordinate coccidium-stimulating properties. The third diet described above is a step in this direction.

This investigation is being supported in part by grants from the American Academy of Arts and Sciences and from the Industrial Science Research Fund at Iowa State College.

ELERY R. BECKER

IOWA STATE COLLEGE

THE FERMENTATION OF CIGAR-LEAF TOBACCO[1]

CONTRARY to the observations of Loew,[2] investigations at the Pennsylvania Agricultural Experiment Station emphasize the significance of microorganisms in the normal fermentation of cigar-leaf tobacco. An epiphytic flora, consisting chiefly of members of the genera *Bacillus, Staphylococcus, Aspergillus, Penicillium, Rhizopus* and *Mucor,* was found upon the cured leaf. During the fermentation, species of the genus *Bacillus* were found to multiply rapidly; agar plate counts of these organisms increased from values of less than 500,000 per gram to values in excess of 2,000,000,000 per gram. Direct counts revealed increases from an initial figure of less than 500,000,000 per gram to counts greater than 15,000,000,000 per gram. The rate of multiplication depended, among other factors, upon the quality of the substrate, the amount of moisture present and the temperature maintained. Although members of this genus were present in the spore state at the end of the curing process, chains of vegetative cells of this group appeared in the early stages of the subsequent fermentation. Two types take part in this extensive multiplication of spore-formers. One type was easily identified as *B. megatherium.* The latter organism represents either a peculiar variation of *B. subtilis,* or it may be classified as a previously undescribed species. The second organism is a slender, motile rod, forming central to excentric spores. The response of this bacillus to biochemical tests corresponds closely to the reactions of *B. subtilis.* Colonies upon agar are spreading, adherent and somewhat mycoides-like.

Staphylococci were frequently observed upon cured and fermenting tobacco. Occasionally the numbers equaled or exceeded those of bacilli, but in many cases the normal fermentation progressed without the appearance of this organism; on the other hand, bacilli were always found in the fermenting tobacco.

Although present in significant numbers on cured tobacco, members of the genera *Aspergillus, Penicillium, Mucor* and related types were found to decrease in number during the course of the fermentation. It was found, however, that an acid-agar medium was of value in the study of cured and curing tobacco. The predominance of *Aspergilli* and *Penicillia* on these plates seemed to indicate a tobacco difficult to ferment. This, apparently, is associated with the degree of complexity of carbohydrate and nitrogenous material in the leaf.

Studies of the catalase activity of the tobacco revealed a direct relation between the number and the activities of the microorganisms on the leaf. Low bacterial counts were invariably accompanied by slight catalase activity and high counts by considerable catalase activity. Any experimental treatment of the leaf that resulted in the inhibition of bacterial growth prevented increases in catalase activity. Any increase in catalase activity was accompanied by an increase in bacterial numbers. Catalase activity was restored to tobacco rendered inactive by heat treatment when inoculated with cultures previously isolated from tobacco.

This work will be reported in detail in a series of technical bulletins of the Pennsylvania Agricultural Experiment Station.

J. J. REID
D. W. MCKINSTRY
D. E. HALEY

PENNSYLVANIA AGRICULTURAL EXPERIMENT STATION,
STATE COLLEGE, PA.

[1] Authorized for publication on July 29, 1937, as paper No. 781 in the Journal Series of the Pennsylvania Agricultural Experiment Station.

[2] O. Loew, "Curing and Fermentation of Cigar-Leaf Tobacco," U. S. Dept. Agr. Rep't. 59, 1899; "Physiological Studies of Connecticut Leaf Tobacco," U. S. Dept. Agr. Rep't. 65, 1900; "Catalase, A New Enzyme of General Occurrence, with Special Reference to the Tobacco Plant," U. S. Dept. Agr. Rep't. 68, 1901.

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